Dermal Risk Assessments for Hydrocarbon Components of Fuel Mixtures

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Goal and Scope. Many dermal exposures in the environment are to mixtures of chemicals. In many cases an evaluation of whether these mixtures are hazardous is necessary. There are two approaches to the assessment of dermal risks with mixtures. One is to go through the risk assessment process (hazard identification, dose-response assessment, exposure assessment and risk characterization) with the chemical mixture of interest. Another approach would be to go through the risk assessment process with the components of mixtures individually and combine them into a risk assessment. The goal of this presentation will be to explore the potential for dermal risk assessment of fuel mixtures based on the component risk assessment approach.

Methods. An understanding of the physicochemical factors involved in dermal absorption and penetration can facilitate doing risk assessments for a fuel mixture using a component approach. Chemical properties such as hydrocarbon chain length and octanol/water partition coefficients (Ko/w) help determine the amount of chemical absorbed into the skin and the amount of chemical that penetrates through the skin. Static diffusion cell studies measuring absorption and penetration with a jet fuel (JP-8) have been accomplished. These studies were carried out for four hours in dermatomed rat skin and the concentrations in skin and receptor solution were analyzed with gas chromatography.

Results and Conclusions. Twelve hydrocarbon components of JP-8 had large enough concentrations in the fuel and penetrated well enough to be detected in the receptor solution. Six aliphatic components could be detected in the skin. These studies showed that the aliphatic components of jet fuel (toluene, naphthalene, ethyl benzene xylene, methyl naphthalenes, trimethyl benzene and dimethyl naphthalenes) penetrate the skin better than the aliphatics (decane, nonane, undecane, tridecane, dodecane). The least liphophilic component, toluene (log Ko/w = 2.69), penetrated fastest and the most lipophilic components, dodecane and tridecane (log Ko/w = 7.24 and 7.57, respectively), penetrated the slowest. The normalized mass in the skin of the aliphatic components also generally correlated inversely with the octanol/water partition coefficient. These results are quite different from what has been observed from aqueous vehicle, and suggest a dramatic effect of JP-8 as a vehicle. They also suggest that both absorption and permeability from a complex mixture, such as jet fuel, are predictable.

Recommendations and Outlook.

- These effects should be confirmed in whole animal studies.
- This approach will be useful for estimating risk from other complex mixtures.
- A better understanding of the impact of a vehicle on the comparative absorption and penetration of chemicals will be useful for risk assessments.